

Activity 1.7: Role cards for debate - Wicked dilemma

Description of role and aim of organization (if relevant) (e.g., producer, government, environmental organization, consumer, health organization, animal protection group)	
Main standpoint/statement in the debate	
Argument(s) to substantiate the statement and defend the position	
Possible criticism from other (identified) groups	
Defense against criticism from above mentioned group(s)	

Activity 5.2: Template for Life Cycle Assessment (LCA)

Use this table template as a frame for your analysis of the two different materials, and as help to look at the materials from several perspectives.

	Original plastic bottle	Bottle from Alternative material
Extraction of raw materials - e.g. soil, land, seed, fertilizer, irrigation		
Manufacturing and processing - e.g. heating, water, ventilation, electricity		
Transportation - e.g. truck, rail, airplane		
Use & trade - e.g. disposable or reusable, life cycle		
Waste disposal - e.g. renewable/non-renewable Raw materials, energy consumption, release of pollutant		

Activity 5.2: Information about, and example of a Life Cycle Assessment (LCA)



Quarterly Problem

- Green Edition -



Life Cycle Assessment – how to do it

→ *Creating a life cycle assessment (LCA) is a really exciting, but also really challenging task. Have you ever wondered, for example, how sustainable the milk is that you put in your cereal for breakfast? No? Then you're not alone - but it's worth thinking outside the box, and it's a lot more exciting than you might think. Because only then can we really understand the impact this product has on the environment. Let's start with this example and see how we could build up an LCA.*

Let's start by taking a close look at our product. What do we have in front of us? Sure, the contents: milk. What else? The carton. What is it made of? Not so easy. Maybe we'll have to ask Google. What's missing? Hmm... there is probably a screw cap. It is made of hard plastic. And the carton is also printed with logos, information and advertising texts. You definitely need ink for that.

These four rough components are best sorted into a table:

Milk	Carton	Screw cap	Print
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Now the really exciting work begins: We embark on a journey with the product. How are these raw materials obtained, what resources are used for this purpose, and what path does the component of our milk carton take before it is assembled into the finished product including the contents? How often is it used before it ends up in the dustbin, and can it be recycled?

In order to get a better overview, let's take a look at the various "life phases" of a product and what you should consider:

- **Extraction of raw materials** - e.g. soil, land, seed, fertilizer, irrigation
- **Manufacturing and processing** - e.g. heating, water, ventilation, electricity
- **Transportation** - e.g. truck, rail, airplane
- **Use & trade** - e.g. disposable or reusable, life cycle
- **Waste disposal** - e.g. renewable/non-renewable raw materials, energy consumption, release of pollutants



In all these considerations, it is useful to pay attention to the following parameters:

- **Greenhouse gas emissions**, e.g. carbon dioxide (CO₂) or methane (CH₄)
- **Water consumption**
- **Land consumption** (e.g. through cultivation of raw materials: On average, how many m² of land must be planted to feed one cow)?

Now evaluate the individual components and then the total product. **Attention, no exact result can be achieved here.** You will probably work a lot with assumptions and speculations, but that is quite normal.

What is the approximate impact of this product on our environment? Can you think of alternatives that are more sustainable? Think about it carefully, after all, you might be the product developer of tomorrow 😊

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Activity 5.2-5.4

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Sources to knowledge – Energy used for production of materials

Material	Relative primary energy used
Steel	XXXXX
Plastics (PE, PVC, PP, PET)	XXXX
Paper and cardboard	XX
Cement	XX
Al alloys	XX
Noble metals (Au, Ag, Cu etc.)	X

Source: <https://royalsocietypublishing.org/doi/pdf/10.1098/rsta.2012.0003>

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Sources and ideas to knowledge and for presentation - Relative Benefit of Cardboard and Plastics

Table. Visualized approx. relative environmental benefit of cardboard and plastics in applications. Both are valued as equal according to functional need.

	Cardboard	Plastics
Renewable raw material	++++	+
Recycled resources	+++	++
Ease of Recycling	+++	++
Durability (benefit)	++	+++
Carbon Footprint	+++	+++
Packing Waste Costs	+++	+++
Lightweight	++	+++

<https://www.procarton.com/wp-content/uploads/2018/06/PC-Carton-Plastic-Sustainability.pdf>

Activity 5.2-5.4

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Plastic waste hierarchy



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Sources to knowledge - Paper/cardboard vs. Plastic European amount of litter, Beach litter and Breakdown

	Paper and Cardboard	Plastic
Total packing waste	XXXXXXXXXX	XXXX
Potential for landfill and leakage	X	XX
European beach litter collected	X	XXXXXXXXXX

Source: <https://www.procarton.com/wp-content/uploads/2018/06/PC-Carton-Plastic-Sustainability.pdf>

Paper breakdown takes months vs. Plastic breakdown takes centuries!

Activity 5.1-5.4

Sources to knowledge – information, statistics and calculators

- Energy used for production of materials
<https://royalsocietypublishing.org/doi/pdf/10.1098/rsta.2012.0003>
- Relative benefit of cardboard and plastic
<https://www.procarton.com/wp-content/uploads/2018/06/PC-Carton-Plastic-Sustainability.pdf>
- Water footprint calculator:
<https://www.watercalculator.org/>
- Environmental footprint calculator. Compare mixed paper, commingled materials, scrap metal and electronics:
<https://www.montgomerycountymd.gov/sws/footprint/>
- Benefit of cardboard and plastic:
<https://www.procarton.com/wp-content/uploads/2018/06/PC-Carton-Plastic-Sustainability.pdf>
- Water consumption - Plastic bottles vs. Aluminium cans:
<https://www.reuters.com/article/us-environment-plastic-aluminium-insight-idUSKBN1WW0J5>
- CO2 impact – glass vs plastic bottles:
<https://ecochain.com/story/case-study-packaging-plastic-vs-glass/>
- Energy used for production of materials:
<https://royalsocietypublishing.org/doi/pdf/10.1098/rsta.2012.0003>
- Ranked: the environmental impact of five different soft drink containers
<https://theconversation.com/ranked-the-environmental-impact-of-five-different-soft-drink-containers-149642>
- Should I buy milk in glass, plastic, or cardboard containers?
<https://slate.com/technology/2011/03/should-i-buy-milk-in-glass-plastic-or-cardboard-containers.html>
- Cartons vs. Plastic containers (Film)
<https://www.youtube.com/watch?v=lxg9F2CC89k>